



National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material[®] 2235

Bismuth for Thermal Analysis

This Standard Reference Material (SRM) is intended for use in calibrating differential scanning calorimeters, differential thermal analyzers, and similar instruments. This SRM consists of a small sample of high purity bismuth, consisting of a 1.5 g shot with diameters of about 1 mm.

The certified value for the enthalpy of fusion and the fusion temperature were measured in an adiabatic calorimeter. Complete details of the measurement method are given in reference 1.

Enthalpy of Fusion
(J/g)

53.146 ± 0.082

Fusion Temperature
(K)

544.556 ± 0.005

The certified values were obtained from a set of 24 measurements made with an adiabatic calorimeter in the temperature range of 514 K to 576 K. The methods used for determination of the certified values are given in reference 2. The temperature was determined with platinum resistance thermometry; the thermometer was calibrated at NIST on the International Temperature Scale of 1990. The enthalpy of fusion is traceable to NIST calibrations of volt, time, and resistance. The uncertainties assigned to the certified values of the enthalpy of fusion and the temperature of fusion were calculated as described in reference 2. The uncertainties correspond to an expansion factor of 2 (95 % confidence) [3].

Expiration of Certification: The certification of this SRM is valid until **01 August 2010**, within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate. However, the certification is invalid if the SRM is damaged, contaminated, or modified.

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive changes occur which affect the certification before the expiration of this certificate, NIST will notify the purchaser. Registration (see attached sheet) will facilitate notification.

The overall direction and coordination of the technical measurements leading to certification were performed by D.G. Archer of the NIST Physical and Chemical Properties Division.

The support aspects involved in the issuance of this SRM were coordinated through the NIST Standard Reference Materials Program by B.S. MacDonald of the NIST Measurement Services Division.

Gregory Rosasco, Chief
Physical and Chemical Properties Division

Gaithersburg, MD 20899
Certification Issue Date: 12 October 2004

Robert L. Watters, Jr., Acting Chief
Measurement Services Division

INSTRUCTIONS FOR USE

There are different calibration methods for differential scanning calorimetry and differential thermal analysis. This material can be used with those protocols to calibrate the temperature and enthalpy flux scales of a differential scanning calorimeter.

Storage and Handling: Bismuth reacts with air. The sample was packaged in 10 ml glass bottles and the glass bottles were sealed in Mylar bags, both under argon in a glove-box. The sample should be stored under an inert gas (e.g. argon or nitrogen). Bismuth used for a set of measurements for calibration should be discarded after several determinations or if the enthalpy or temperature values begin to drift with subsequent determinations.

REFERENCES

- [1] Archer, D.G.; Rudtsch, S.; *Enthalpy of Fusion of Indium: A Certified Reference Material for Differential Scanning Calorimetry*; J. Chem. Eng. Data, Vol. 48, pp. 1157-1163 (2003).
- [2] Archer, D.G.; *Enthalpy of Fusion of Bismuth: A Certified Reference Material for Differential Scanning Calorimetry*; J. Chem. Eng. Data, Vol. 49, pp. 1364-1367 (2004).
- [3] ISO; *Guide to the Expression of Uncertainty in Measurement*; ISBN 92-67-10188-9, 1st ed.; International Organization for Standardization: Geneva, Switzerland (1993); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297; U.S. Government Printing Office: Washington, DC (1994); available at <http://physics.nist.gov/Pubs/>.

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: telephone (301) 975-6776; fax (301) 926-4751; email srminfo@nist.gov; or via the Internet at <http://www.nist.gov/srm>.